Citation:

Kabagambe EK, Baylin A, Ruiz-Narvarez E, Siles X, Campos H. Decreased consumption of dried mature beans is positively associated with urbanization and nonfatal acute myocardial infarction. *J Nutr.* 2005 Jul;135(7):1770-5.

PubMed ID: 15987863

Study Design:

Case-Control Study

Class:

C - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

POSITIVE: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To determine whether consumption of dried mature beans, the main legume in Latin America, is associated with myocardial infarction.

Inclusion Criteria:

- Cases:
  - men and women diagnosed as survivors of a first acute myocardial infarction (MI) by 2 independent cardiologists at any of the 6 recruiting hospitals in the catchment area
    - all cases met the WHO criteria for MI, which require typical symptoms plus either elevations in cardiac enzyme concentrations or diagnostic changes in the electrocardiogram
- Controls (matched with cases):
  - $\pm$ 5 years of age of matched case
  - sex
  - area of residence

Exclusion Criteria:

- Cases:
  - death during hospitalization
  - $\geq$ 75 years on the day of the first MI
  - physically or mentally unable to answer the questionnaire
- Controls:
  - history of MI
  - physically or mentally unable to answer the questionnaires

Description of Study Protocol:

Recruitment: Cases identified by fieldworkers who carried out daily visits to 6 participating hospitals.

Design: Case-control study

Blinding used (if applicable): Not specified

Intervention (if applicable): not applicable

Statistical Analysis:

- Subjects with missing values for major confounders were excluded from analysis
- Significance of differences in the distribution of categorical variables by case-control status: McNemar's test
- Significance of difference in continuous variables: paired t-test, if normally distributed; Wilcoxon signed rank tests, if not normally distributed
- Individual nutrient intakes adjusted for energy intake
- Continuous nondietary and energy-adjusted dietary variables were distributed into quintiles and assessed for potential confounding by distributing them by categories of intake of beans and by testing their effect on the model parameter estimates and likelihood ratio test
- Potential mechanisms for the inverse association between consumption of beans and MI investigated by adjusting for major nutrients from beans (fiber, b-vitamins, iron, copper, zinc, potassium, magnesium, and alpha-linolenic acid) and determining if association between beans and MI was modified
- Variables associated with consumption of beans among controls: stepwise multivariate linear regression
    - outcome variable: semicontinuous variable from food frequency questionnaire (i.e. servings of beans/day) with values of:
        - 0
        - 0.08
        - 0.14
        - 0.43
        - 0.8
        - 1
        - 2.5
        - 4.5
    - categorical variables included in model:
        - sex
        - area of residence
        - smoking
        - alcohol consumption (yes, no)
        - history of diabetes
        - history of hypertension
        - occupation
    - continuous variables included in model (a unit change = 1 SD increase):
        - age
        - sedentary lifestyle (inverse of physical activity)
        - abdominal obesity
        - education (years)

- income
- Major variables associated with consumption of beans: identified from simple β-coefficients and standardized β-coefficients from multiple linear regression

Data Collection Summary:

Timing of Measurements

Data collected by trained personnel after recruitment to study.

Dependent Variables

- First acute MI: determined by 2 independent cardiologists, with consideration of presence of typical symptoms plus either elevations in cardiac enzyme concentrations or diagnostic changes in the electrocardiogram
- Plasma blood lipids
  - triacylglycerol (TG)
  - total cholesterol (TC)
  - HDL-cholesterol (HDL-C)
  - LDL-cholesterol (LDL-C) - Friedewald equation
- Adipose tissue fatty acids - subcutaneous adipose tissue biopsy from upper buttock
- Anthropometric measurements (methods not specified)

Independent Variables

- Consumption of beans - semiquantitative food frequency questionnaire (FFQ) validated for Costa Rican population; intake was corresponded to 1 of 9 categories, where 1 time = 1/3 cup (86 g) of cooked beans:
  - < 1 time/month or never
  - 1-3 times/month
  - 1 time/week
  - 2-4 times/week
  - 5-6 times/week
  - 1 time/day
  - 2-3 times/day
  - 4-5 times/day
  - 6+ times/day

Control Variables

- medical history data - interview
  - self-reported diabetes and hypertension - validated using the definitions recommended by the Expert Committee on the Diagnosis and Classification of Diabetes Mellitus and the Third Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure
- smoking (never, past, < 20 or ≥ 20 cigarettes/day) - interview
- alcohol intake (never, past, current drinkers in tertiles)
- abdominal obesity based on waist/hip ratio in quintiles
- physical activity in quintiles - interview
- income, in quintiles - interview
- total energy intake, in quintiles

- saturated fat intake, in quintiles
- trans-fat intake, in quintiles
- polyunsaturated fat intake, in quintiles
- dietary cholesterol, in quintiles

Description of Actual Data Sample:

Initial N: N = 2429 cases; N = 2429 controls

Attrition (final N): N = 2119 cases, N = 2119 controls (males: 73%; females: 27%)

Age: mean (SD): cases: 59 ± 11; controls: 58 ± 11 years

Ethnicity: Hispanic Americans in Costa Rica central valley

Other relevant demographics:

- Household income (U.S. dollars): mean ± SD
  - Cases: 496 ± 390
  - Controls: 571 ± 427
  - P < 0.05
- Secondary education or higher (%)
  - Cases: 37%
  - Controls: 40%
  - P < 0.05

Anthropometrics

- Abdominal obesity (based on waist/hip ratio): mean ± SD
  - Cases: 0.97 ± 0.07
  - Controls: 0.95 ± 0.08
  - P < 0.05

Location: Costa Rica

Summary of Results:

Key Findings

- Consumption of >1 servings of beans/day was significantly higher (P < 0.001) in rural (81%) than in urban (65%) areas
- Individuals who never eat dried beans or whose consumption was <1 time per month were classified as nonconsumers
- Compared with nonconsumers, intake of 1 serving of beans/day was inversely associated with MI in adjusted analyses (odds ratio = 0.62, 95% CI: 0.45 - 0.88).
- No further protection was observed with increased number of servings/day (odds ratio = 0.73, 95% CI: 0.52 - 1.03 for >1 serving/day).

Study population:

- Controls were:
  - less likely to be current smokers (P < 0.05)

- less likely to have a history of diabetes or hypertension ($P < 0.05$)
- more likely than cases ($P < 0.05$) to be:
    - current drinkers (52% vs. 49%)
    - more physically active (1.56 ± 0.70 vs 1.51 ± 0.69 MET)
    - thinner
    - more educated
    - higher income
- consumed, compared to cases ($P < 0.05$)
    - less total energy (10,250 + 3211 vs 11,318 $\pm$ 3938 kJ)
    - less saturated fat (10 ± 3 vs 11 ± 3 % energy)
    - less cholesterol (118 ± 52 vs 126 ± 59 mg/4187 kJ)
    - more polyunsaturated fat (6.2 ± 2.0 vs 6.0 ± 2.0 % total energy)

- Consumption of beans among controls
    - was negatively associated with sex, urbanization, history of hypertension, income, and total and LDL-C, but was positively associated with smoking, physical activity, and somewhat with abdominal obesity
        - 69% of the population consumed at least 1 serving of beans/day
        - consumption of 1 serving/day was higher in men (73%) than women (59%), $P < 0.001$
        - consumption of 1 serving/day was higher in rural (81%) compared with urban areas (65%)
- Distribution of age-standardized potential dietary confounders by frequency of consumption of beans among controls:
    - intake of total fat, monounsaturated fat, cholesterol, fruits, vegetables, and soybean oil decreased with an increase in intake of beans
    - total energy, folate, magnesium, copper, iron, white rice, and palm oil increased with an increase in intake of beans.
    - In multivariable linear models (including age, gender, physical activity) - higher abdominal obesity and increase in total energy intake in the top compared with the lowest category of intake of beans was due in part to the high proportion of men in the top group for both variables and also to physical activity for energy intake

Factors determining consumption of beans

- Decreased consumption of beans was associated with
    - female gender ($P < 0.0001$)
    - higher income ($P < 0.0001$)
    - being a nonsmoker ($P < 0.02$)
    - sedentary lifestyle ($P < 0.0001$)
    - increasing age ($P < 0.001$)
- Compared with men, especially in urban areas, women were less likely to have multiple servings of beans daily

Relation between beans and MI

- Moderate consumption (1 serving/day) was associated with a reduced risk of MI
    - basic analyses: OR = 0.69 (95% CI: 0.51 - 0.91)
    - multivariate analyses: OR = 0.62 (95% CI: 0.45 - 0.88)
- Consumption of beans at > 1 serving/day was inversely associated with risk of MI, but was NS (multivariate adjusted OR = 0.73 (95% CI: 0.52 - 1.03)
- When model was fitted for type of oil used for cooking or frying and including confounders,

results not modified appreciably:

- 1 serving beans/day: OR = 0.69 (95% CI: 0.50 - 0.96)
- > 1 serving beans/day: OR = 0.81 (95% CI: 0.58 - 1.12)

Sources of micronutrients and contribution of beans

- When tested whether major nutrients in beans could explain individually or in multivariate models the observed association between beans and MI: none of the nutrients (i.e. protein, fiber, folate, vitamin B-6, magnesium, copper, iron) affected the association between beans and MI
- Alpha-linolenic acid (assessed in adipose tissue) increased with the number of servings of beans (irrespective of type of oil used for cooking)

Intake of dried mature beans and risk of nonfatal acute MI among Costa Rican adults[1,2]

	Servings of dried beans/day			
	0	< 1	1	>1
N	232	1062	1151	1793
Multivariate 1[3]	1.00	0.78 (0.56 - 1.10)	0.63 (0.45 - 0.87)	0.74 (0.53 - 1.03)
Multivariate 2[4]	1.00	0.76 (0.54 - 1.08)	0.62 (0.45 - 0.88)	0.73 (0.52 - 1.03)

[1]Values are OR (95% CI)

[2]One serving is ~ 86 g or one-third cup of cooked beans

[3]Adjusted for smoking, history of diabetes, history of hypertension, abdominal obesity, physical activity, household income, and intake of total energy and alcohol

[4]In addition, adjusted for intake of saturated fat, *trans* fat, polyunsaturated fat, and dietary cholesterol

Author Conclusion:

Consumption of 1 serving/day (~86 g) of beans is associated with a 38% lower risk of MI; no additional protection is observed at intakes > 1 serving/day.

Reviewer Comments:

Adjusted for several confounding variables.

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions

1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	Yes
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	Yes

Validity Questions

1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**	Yes
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	Yes
2.4.	Were the subjects/patients a representative sample of the relevant population?	Yes
3.	**Were study groups comparable?**	Yes
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	N/A
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	Yes
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	Yes
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	N/A

3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	Yes
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	Yes
4.1.	Were follow-up methods described and the same for all groups?	N/A
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	Yes
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	Yes
4.4.	Were reasons for withdrawals similar across groups?	N/A
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**	Yes
5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	N/A
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	Yes
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	N/A
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	Yes
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	N/A
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	Yes
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	N/A
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	N/A

6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	N/A
6.6.	Were extra or unplanned treatments described?	N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	N/A
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A
7.	**Were outcomes clearly defined and the measurements valid and reliable?**	Yes
7.1.	Were primary and secondary endpoints described and relevant to the question?	Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	Yes
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	Yes
7.5.	Was the measurement of effect at an appropriate level of precision?	Yes
7.6.	Were other factors accounted for (measured) that could affect outcomes?	Yes
7.7.	Were the measurements conducted consistently across groups?	Yes
8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**	Yes
8.1.	Were statistical analyses adequately described and the results reported appropriately?	N/A
8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	N/A
8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	Yes
8.6.	Was clinical significance as well as statistical significance reported?	Yes
8.7.	If negative findings, was a power calculation reported to address type 2 error?	N/A
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**	Yes
9.1.	Is there a discussion of findings?	Yes

	9.2.	Are biases and study limitations identified and discussed?	Yes
10.	**Is bias due to study's funding or sponsorship unlikely?**		Yes
	10.1.	Were sources of funding and investigators' affiliations described?	Yes
	10.2.	Was the study free from apparent conflict of interest?	Yes